Sandy Hook to Cape Henry

(1) Between New York Bay and Delaware Bay is the New Jersey coast with its many resorts, its inlets, and its Intracoastal Waterway. Delaware Bay is the approach to Wilmington, Chester, Philadelphia, Camden, and Trenton; below Wilmington is the Delaware River entrance to the Chesapeake and Delaware Canal, the deep inside link between Chesapeake and Delaware Bays. The Delaware-Maryland-Virginia coast has relatively few resorts; the numerous inlets are backed by a shallow inside passage that extends all the way from Delaware Bay to Chesapeake Bay. The last seven chapters, nearly half of this book, are required to describe Chesapeake Bay to Norfolk and Newport News, to Washington and Baltimore, and to Susquehanna River 170 miles north of the Virginia Capes.

(2) A vessel approaching this coast from seaward will be made aware of its nearness by the number of vessels passing up and down in the coastal trade. The coast of New Jersey is studded with large hotels, prominent standpipes, and elevated tanks. South of Delaware Bay, the principal landmarks are the lighthouses and Coast Guard stations.

(3) The general tendency along this mostly sandy coast is for the ocean beaches and the points on the north sides of the entrances to wash away and for the points on the south sides of the entrances to build out. Protective works have done much to stabilize the New Jersey coast, but several lighthouses have been abandoned between Delaware Bay and Chesapeake Bay because of erosion.

(4) The shores of Delaware Bay and Delaware River are mostly low and have few conspicuous marks, other than lights, below the industrial centers along the river. The shores of Chesapeake Bay are low as far north as Patuxent River, then rise to considerable heights at the head of the bay.

Disposal Sites and Dumping Grounds

(5) These areas are rarely mentioned in the Coast Pilot, but are shown on the nautical charts. (See Disposal Sites and Dumping Grounds, chapter 1, and charts for limits.)

Aids to navigation

(6) Lights are numerous along the section of the coast covered by this Coast Pilot. Fog signals are at most of the principal light stations. Many coastal and harbor buoys are equipped with radar reflectors, which greatly increase the range at which the buoys may be detected on the radarscope. The critical dangers are marked.

Loran

(7) Loran C stations provide the mariner with good navigation coverage along this section of the coast.

Radar

(8) **Radar**, though always a valuable navigational aid, is generally of less assistance in navigation along this coast due to the relatively low relief; the accuracy of radar ranges to the beach cannot be relied upon. Coastal buoys equipped with radar reflectors are of help in this regard. It is sometimes possible to obtain a usable radar return from the larger lighthouses, but positive target identification is usually difficult. Radar is of particular importance in detecting other traffic and in the prevention of collisions during periods of inclement weather, and in fog and low visibility.

COLREGS Demarcation Lines

(9) Lines have been established to delineate those waters upon which mariners must comply with the International Regulations for Preventing Collisions at Sea, 1972 (72 COLREGS) and those waters upon which mariners must comply with the Inland Navigational Rules Act of 1980 (Inland Rules). The waters inside of the lines are **Inland Rules Waters,** and the waters outside of the lines are **COLREGS Waters.** (See **Part 80,** chapter 2, for specific lines of demarcation.)

Ports and Waterways Safety

(10) (See **Part 160**, chapter 2, for regulations governing vessel operations and requirements for notification of arrivals, departures, hazardous conditions, and certain dangerous cargoes to the Captain of the Port.)

(11)

Regulated Navigation Areas

(12) **Regulated Navigation Areas** have been established within the navigable waters of the First Coast Guard District to increase operational safety for towing vessels and tank barges. (See **165.100**, chapter 2, for limit and regulations.)

Harbor and Inlet Entrances

(13) The channels into Delaware and Chesapeake Bays are broad and deep. The entrances to the inlets are comparatively shallow and are more or less obstructed by shifting sandbars. Some of the inlets have been improved by dredging and by the construction of jetties. On many of the bars the buoys are moved from time to time to mark the shifting channels. The best time to enter most of the inlets is on a rising tide with a smooth sea. Strangers should not attempt to enter the inlets without assistance when the seas are breaking on the bars. The tidal currents have considerable velocity in all of the entrances, and their direction is affected by the force and direction of the wind.

Traffic Separation Schemes

(14) **Traffic Separation Schemes (Traffic Lanes)** have been established at the entrances to New York Harbor, Delaware Bay and Chesapeake Bay, and in the main channel of Chesapeake Bay off Smith Point just south of the entrance to the Potomac River. (See chapters 4, 6, 9, and 12, respectively, for details.)

Anchorages

(15) The only protected anchorage for deep-draft vessels between New York Bay and Chesapeake Bay is outside the channel limits in Delaware Bay according to draft. Absecon Inlet, Cape May Inlet, and some of the others can accommodate light-draft vessels such as trawlers and small yachts, but not medium or deep drafts. Small local craft often seek shelter inside the shallower inlets, but entrance is difficult in heavy weather, and the unimproved inlets are often difficult even in good weather, particularly for strangers.

(16) A number of anchorage areas have been established by Federal Regulations within the area of this Coast Pilot. (See **Part 110,** chapter 2, for limits and regulations.)

(17) The chapters that follow may contain references to Federally-designated Marine Managed Areas (MMAs) occurring in navigable coastal waters of the United States mid-Atlantic coast. A summary of these MMAs can be found in Appendix C. The critical environmental information is intended to inform readers about the location, purpose, and legal restrictions of coastal MMAs, with an emphasis on activities of interest to the maritime community. (Extensive MMAs are listed here. Regional MMAs are included in subsequent chapters of this Coast Pilot.)

(18) **Southern Nearshore Lobster Waters** includes waters along the continental shelf of the Mid-Atlantic coast from Long Island to Cape Hatteras. (See **MMA 3-1**, Appendix C, for additional information.)

(19) **Waters off New Jersey Closure** are located along the NJ and Long Island coasts extending N to RI and S to DE. (See **MMA 3-2**, Appendix C, for additional information.)

(20) **Mid-Atlantic Coastal Waters Area** includes coastal area between NY and NC/SC border. (See **MMA 3-3**, Appendix C, for additional information.)

(21) **Other Northeast Gillent Waters Area** includes large area off Mid-Atlantic and New England coastlines. In Mid-Atlantic area, includes waters east of 33°51'W. (See **MMA 3-4**, Appendix C, for additional information.)

(22) **Offshore Lobster Waters**, about 60 miles offshore to the Exclusive Economic Zone (EEZ) edge, extend from the U.S./Canadian border to Cape Hatteras, NC. (See **MMA 3-5**, Appendix C, for additional information.)

(23) S**outhern Mid-Atlantic Waters Closure Area** is bounded by DE coast on the N and NC/SC borders on the S. (See **MMA 3-6**, Appendix C, for additional information.)

Dangers

(24) The principal dangers along this coast are the outlying sand shoals, the fogs, and the doubtful direction and velocity of the currents after heavy gales. Depths of 7½ fathoms are found as far as 20 miles from shore. There are many wrecks along this coast, but most of them have been blasted off or cleared to safe navigational depths; the others are marked by obstruction buoys.

(25) Gales from northeast to southeast cause heavy breakers on the beaches and outlying shoals; the sea breaks in 4 to 5 fathoms of water, and shoals of that depth or less usually are marked during easterly gales. The bars across the inlets are then impassable and are defined by breakers even in comparatively smooth water with a light swell. The heaviest surf on the beach is on a rising tide near high-water springs; the least surf is encountered on a falling tide near low water. A very heavy surf makes on the beaches after a southeasterly gale followed by a sudden shift of wind to northwest.

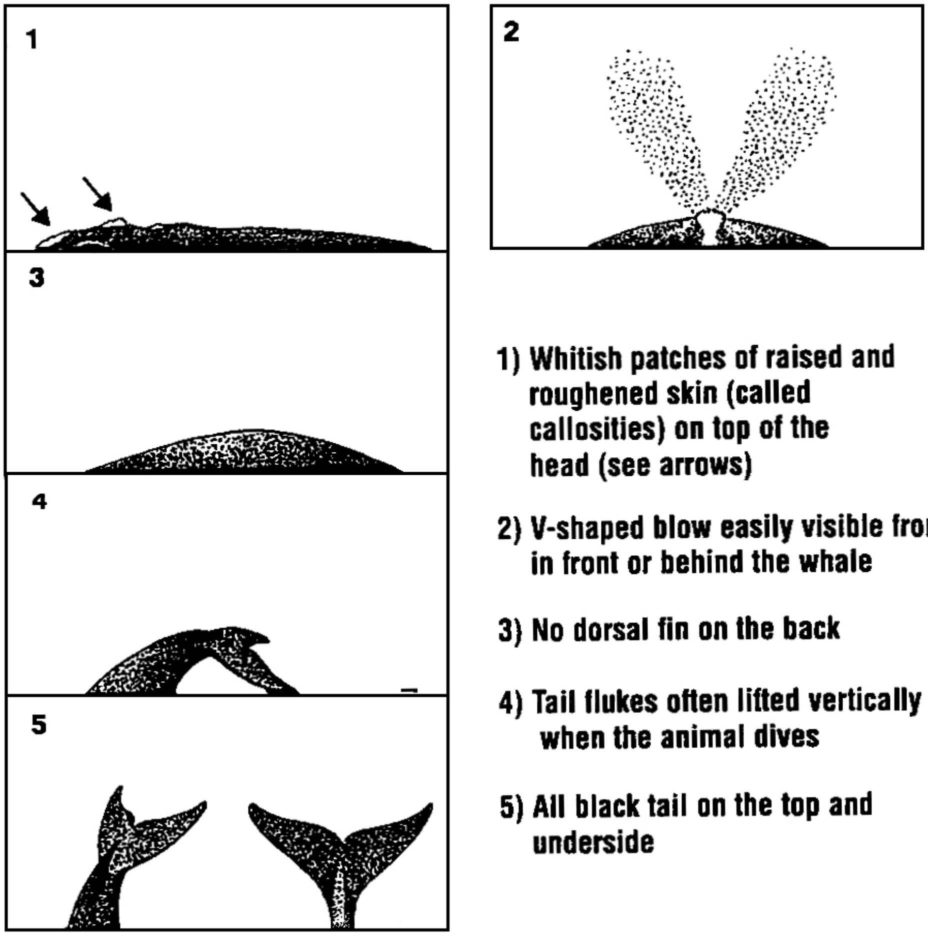
Danger zones

(26) **Danger zones** have been established within the area of this Coast Pilot. (See **Part 334,** chapter 2, for limits and regulations.)

North Atlantic Right Whales

(27) North Atlantic right whales are one of the world's most endangered large whale species. Because right whales mate, rest, feed and nurse their young at the surface, and may not move out of the ship's way, they are highly vulnerable to being struck by ships. Ship

North Atlantic right whale



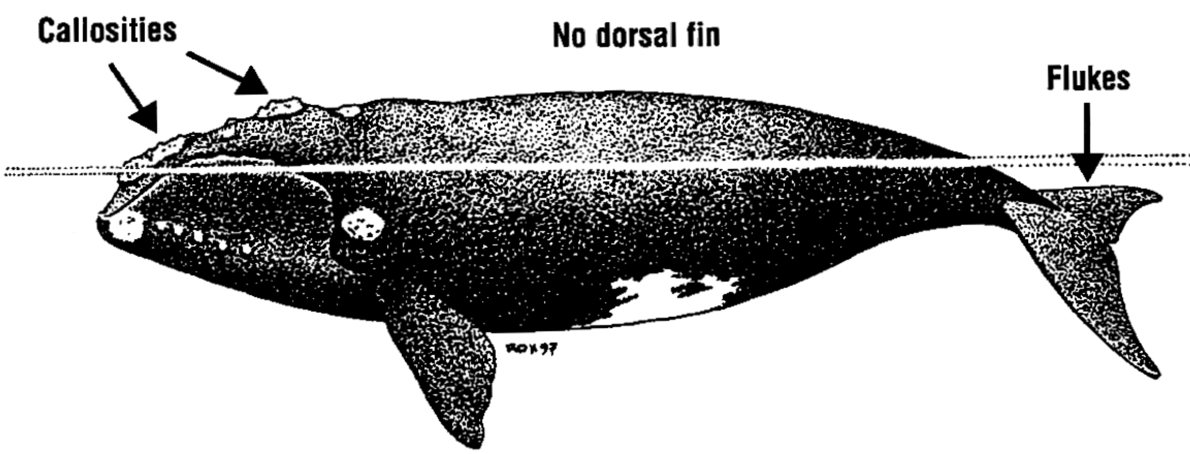
1) Whitish patches of raised and roughened skin (called callosities) on top of the head (see arrows)

2) V-shaped blow easily visible from in front or behind the whale

3) No dorsal fin on the back

4) Tail flukes often lifted vertically when the animal dives

5) All black tail on the top and underside



strikes are one of the leading known sources of human-related mortality to right whales. Mariners are requested to use caution to avoid colliding with right whales. Right whales migrate annually along the east coast between the northen feeding grounds off New England and Canada and the southern calving area off Florida, Georgia and South Carolina. Right whales are frequently sighted within 30 miles of the Atlantic coast between Cape Cod and South Carolina from February through April (northern migration) and from September through December (southern migration). Calves returning north with their mothers appear to be particularly susceptible to collision with ships.

(28) **Seasonal occurrence of North Atlantic right whales:** In seasons and in areas where right whales may occur, vessel operators should maintain a sharp lookout for right whales. Right whales occur seasonally throughout their range from Canada to Florida. The peak occurrence of right whales in the mid-Atlantic is generally from November through April as they migrate between the winter calving areas off the southeastern United States and the northern feeding grounds off New England and Canada. Migrating whales are commonly within 30 nautical miles of shore.

(29) **Description of North Atlantic right whale:** The species reaches lengths of 45 to 60 feet and is black in color. The best identification marks are a broad back with no dorsal fin, irregular bumpy white patches (callosities) on the head and a distinctive two-column V-shaped blow when viewed from directly behind or in front of the whale. They have broad paddle-shaped flippers and a broad, deeply notched tail. See the following diagrams.

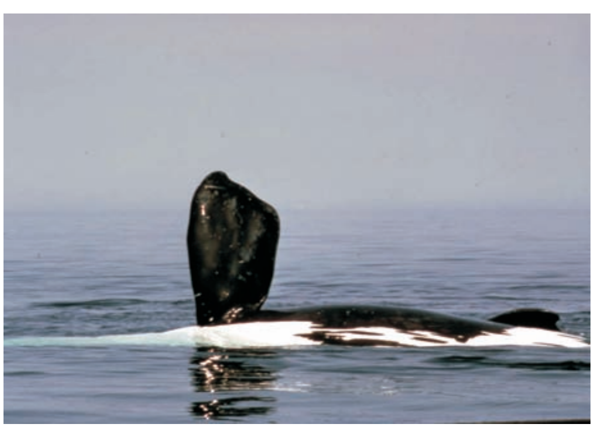
(30) **Early Warning System (EWS) and Sighting Advisory System (SAS):** As weather and conditions permit, dedicated seasonal programs of right whale aerial surveys in the northeast and southeast U.S. provide right whale sighting information to the Coast Guard and other sources for broadcast to mariners from various media. Few dedicated aerial surveys occur off the coast from Sandy Hook, New Jersey to Cape Henry, Virginia. As a result, many right whales in the mid-Atlantic area go undetected. However, limited sighting reports in the mid-Atlantic are distributed through the EWS and SAS.

(31) **Precautions:** NOAA recommends that the following precautionary measures be taken to avoid North Atlantic right whales.

(32) As soon as possible prior to entering areas in which right whales may occur, check Coast Guard Broadcast Notices to Mariners, NAVTEX, NOAA Weather Radio, Mandatory Ship Reporting System and other sources for recent right whale sighting reports. To the extent possible, review right whale identification materials and maintain a sharp watch with lookouts familiar with spotting whales. Local ship's pilots may also provide additional whale information.

(33) When planning passage within 20 nautical miles of a recently reported right whale sighting location, NOAA recommends the following: a. Reduce speed to below 12 knots, if the safety of navigation permits. b. Attempt to avoid night-time transits c. Minimize travel distances through the area whenever possible d. Anticipate delays due to whale sightings and e. Post a lookout familiar with spotting whales.

(34) If a right whale is spotted from a ship, mariners should exercise caution and proceed at speeds below 12 knots if the safety of navigation permits, bearing in mind that reduced speed will minimize the risk of ship strikes. Right whales have been killed by vessels traveling at 15 knots or greater.



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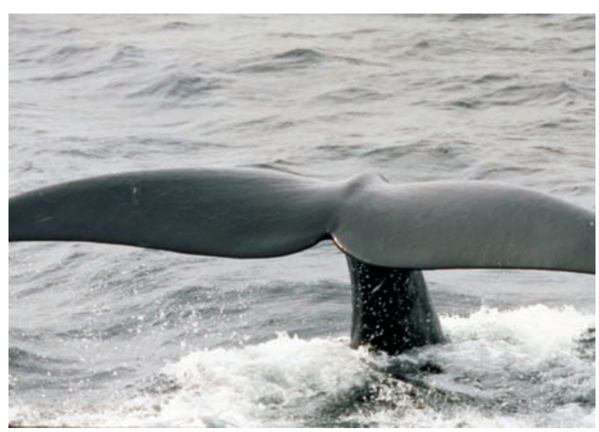
The right whales' unique paddle-shape flippers



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Note the right whales' deeply notched tail fluke

(35) Local ships' pilots may also provide additional information on the location of right whales and local safe vessel operating procedures.

(36) Do not assume right whales will move out of your way. Right whales seldom travel faster than 5-6 knots. Consistent with safe navigation, maneuver around observed right whales or recently reported sighting locations. It is illegal to approach closer than 500 yards of any right whale (see **50 CFR 224.103(c)**, chapter 2).

(37) If any whale is accidentally struck, or if any dead or entangled whale is observed, it should be reported immediately to the Coast Guard noting the precise location and time of the accident or sighting. In the event of a strike or sighting, the following information should be provided to the Coast Guard:

(38) location, date, and time of the accident or sighting of a carcass or entangled whale.

(39) speed of the vessel

(40) size of the vessel

(41) water depth

(42) wind speed and direction

(43) description of the impact

(44) fate of the animal

(45) species and size, if known

(46) Right whales can occur anywhere along the east coast. Therefore, mariners are urged to exercise prudent seamanship in their efforts to avoid right whales.

Mandatory Ship Reporting Systems. MSR (North Atlantic right whales) WHALESNORTH and WHALESSOUTH

(47) Mandatory Ship Reporting (MSR) systems require all vessels, 300 gross tons or greater, to report to the U.S. Coast Guard prior to entering two designated reporting areas off the east coast of the United States. (See **33 CFR 169**, chapter 2, page , for limits and regulations.) Sovereign immune vessels are exempt from the requirement to report, but are encouraged to participate.

(48) The two reporting systems will operate independently of each other. The system in the northeastern United States will operate year round and the system in the southeastern United States will operate each year from November 15 through April 15. Reporting ships are only required to make reports when entering a reporting area during a single voyage (that is, a voyage in which a ship is in the area). Ships are not required to report when leaving a port in the reporting area nor when exiting the system.

(49) Mariners should check all MSR messages carefully before transmitting to ensure that the message includes the correct address and format. Additional greeting or comments in the message will preclude message receipt by the MSR system. Failure to receive a timely return message from the MSR system that provides locations of recent right whale sightings and precautionary guidance should be reported to the local Marine Safety Office of the U.S. Coast Guard.

(50) **Northeastern reporting system/Southeastern reporting system** (See **33 CFR 169.105 and 169.115**, chapter 2, for limits.)

(51) Vessels shall make reports in accordance with the format in IMO Resolution A.858 (20) in accordance with the International Convention for the Safety of Life at Sea 1974 (SOLAS 74). (See **33 CFR 169.135 and 169.140**, chapter 2, for additional information.) Vessels should report via INMARSAT C or via alternate satellite communications to one of the following addresses:

(52) Email: RightWhale.MSR@noaa.gov or Telex: 23673 7831

(53) Vessels not equipped with INMARSAT C or Telex should submit reports to the U.S. Coast Guard's Communication Area Master Station Atlantic (CAMSLANT) via narrow band direct printing (SITOR) or HF voice. Vessels equipped only with VHF-FM voice communications should submit reports to the nearest U.S. Coast Guard activity or group.

(54) Example Reports:

(55) **WHALESNORTH** – To: RightWhale.MSR@noaa.gov

(56) WHALESNORTH//

(57) M/487654321//

(58) A/CALYPSO/NRUS//

(59) B/031401Z APR//

(60) E/345//

(61) F/15.5//

(62) H/031410Z APR/4104N/06918W//

(63) I/BOSTON/032345Z APR//

(64) L/WP/4104N/06918W/15.5.//

(65) L/WP/4210N/06952W/15.5//

(66) L/WP/4230N/07006W/15.5//

(67) **WHALESSOUTH** – To: RightWhale.MSR@noaa.gov

(68) WHALESSOUTH//

(69) M/412345678//

(70) A/BEAGLE/NVES//

(71) B/270810Z MAR//

(72) E/250//

(73) F/17.0//

(74) H/270810Z MAR/3030N/08052W//

(75) I/MAYPORT/271215Z MAR//

(76) L/RL/17.0//

(77) **Fishweirs** are numerous along the outside coast and in Chesapeake Bay and tributaries. The stakes often become broken off and form a hazard to navigation, especially at night. Regulations limiting the areas within which fishweirs may be established have been prescribed by the Chief of Engineers, U.S. Army. The areas

within which fishweirs are permitted are shown on charts of 1: 80,000 scale and larger. The exact locations of the weirs within the designated areas are not shown.

(78) Along the outer coasts the limits of fishweir areas are not marked. In Chesapeake Bay and tributaries, black and white horizontal-banded buoys mark the turns of the limits. Strangers should proceed with caution when crossing areas of possible fishweirs, and should avoid crossing such areas at night.

Pipelaying barges

(79) With the increased number of pipeline laying operations, operators of all types of vessels should be aware of the dangers of passing close aboard, close ahead, or close astern of a jetbarge or pipelaying barge. Pipelaying barges and jetbarges usually move at 0.5 knot or less and have anchors which extend out about 3,500 to 5,000 feet in all directions and which may be marked by lighted anchor buoys. The exposed pipeline behind the pipelaying barge and the area in the vicinity of anchors are hazardous to navigation and should be avoided. The pipeline and anchor cables also represent a submerged hazard to navigation. It is suggested, if safe navigation permits, for all types of vessels to pass well ahead of the pipelaying barge or well astern of the jetbarge. The pipelaying barge, jetbarge, and attending vessels may be contacted on VHF-FM channel 16 (156.80 MHz) for passage instructions.

Drawbridges

(80) The general regulations that apply to all drawbridges are given in **117.1 through 117.49,** chapter 2, and the specific regulations that apply only to certain drawbridges are given in **Part 117, Subpart B,** chapter 2. Where these regulations apply, references to them are made in the Coast Pilot under the name of the bridge or the waterway over which the bridge crosses.

(81) The drawbridge opening signals (see **117.15,** chapter 2) have been standardized for most drawbridges within the United States. The opening signals for those few bridges that are nonstandard are given in the specific drawbridge regulations. The specific regulations also address matters such as restricted operating hours and required advance notice for openings.

(82) The mariner should be acquainted with the general and specific regulations for drawbridges over waterways to be transited.

Routes

(83) Deep-draft vessels should stay outside of Barnegat Lighted Horn Buoy B and Five Fathom Bank Lighted Buoy F between New York Harbor and Delaware Bay, and outside Delaware Lighted Buoy D, Jack Spot Buoy 2JS (38°05.3'N., 74°45.1'W.), and Chesapeake Light between Delaware Bay and Chesapeake Bay. Traffic is heavy along this coast, and a sharp lookout must be kept to avoid collision. Vessels should approach Delaware Bay and Chesapeake Bay through the Traffic Separation Schemes that have been established off the entrances to these bays.

Inside Navigation

(84) Navigation on the waterways covered by this volume requires a knowledge of the channel conditions and other factors restricting navigation. General items of interest to the vessel operator are indicated in the paragraphs that follow; details are given in the text.

Federal regulations

(85) (See **207.100,** chapter 7, for the regulations governing the use, administration and navigation of the Chesapeake and Delaware Canal.)

Bends and curves

(86) The New Jersey Intracoastal Waterway and adjoining waterways have many sharp bends which are dangerous to vessels meeting or passing. On approaching a bend a vessel should reduce speed sufficiently to be able to stop within half the distance to a ship coming from the opposite direction. Under no circumstances should a vessel attempt to overtake and pass another at a bend. Even with sufficient view of the channel ahead and after proper exchange and understanding of signals, the overtaken vessel may suddenly sheer from current action. This is even more pronounced with larger vessels and tows.

Cross currents

(87) Where two streams cross, the current will have a greater velocity in the deeper channel. This is noticeable along the New Jersey Intracoastal Waterway where it follows a dredged canal cutting across a winding stream. Cross currents will also be noticed where either an inlet from the ocean or a drainage canal enter the waterway.

(88) Cross currents are especially strong at Beach Haven Inlet, Absecon Inlet, Townsend Inlet, and Tuckerton Creek. Failure to allow for cross currents when passing these and other inlets has resulted in many rescue calls to the Coast Guard.

Stumps and sunken logs

(89) Reports are frequently made that vessels have struck shoals or rocks in rivers which have later proved to be stumps or sunken logs. Mariners are warned against navigating too close to the banks of streams where submerged stumps are known or may be expected to exist.

Hurricane moorings

(90) On receiving an advisory notice of a tropical disturbance, small boats should seek shelter in a small winding stream whose banks are lined with trees, preferably trees with deep roots. Moor with bow and stern lines fastened to the lower branches; if possible snug up with good chafing gear. The knees of the trees will act as fenders, and the branches, having more give than the trunks, will ease the shocks of the heavy gusts. If the banks are lined only with small trees or large shrubs, use clumps of them within each hawser loop. Keep clear of any tall pines or other shallow-rooted trees, since they generally are more apt to be blown down.

Tides

(91) The mean range of tide is 3.4 to 4.4 feet along the coast. In passages away from the inlets, the range may be as little as 0.5 foot. In Delaware River the mean range reaches 6.8 feet at Trenton, while in Chesapeake Bay the mean range is only 1.1 feet at Baltimore.

Currents

(92) Rotary currents and Gulf Stream currents could be discussed at considerable length, but the important currents are those in the inlets and the inside passages; the tidal currents have considerable velocity in all of the entrances, and their direction is affected by the force and direction of the wind.

Ice

(93) The intracoastal passages of New Jersey, Delaware, and Maryland usually are closed by ice during ordinary winters; the Virginia passages are closed only during severe winters and then only for short periods. Local vessels use all the inlets and adjacent channels from Sandy Hook to Cape Charles all winter, even when through navigation is blocked.

(94) In Delaware River, ice is present in sufficient amounts even in ordinary winters to be of some concern. The Chesapeake and Delaware Canal is kept open as long as possible, but may be closed at times. In severe winters, navigation has been interrupted above Chester but tugs and large vessels keep the channels open to Philadelphia. Above Philadelphia, the river may be closed for extended periods in January and February, and navigation is practically suspended during severe winters.

(95) Ice seldom interferes with navigation of full-powered vessels in Hampton Roads even in severe winters. Large vessels can always pass up and down Chesapeake Bay, but ice jams are of frequent occurrence off Baltimore Harbor. The harbor itself sometimes freezes over and navigation may be blocked for small, low-powered vessels for limited periods.

(96) Conditions in other Chesapeake Bay tributaries are somewhat similar to those in the same latitudes along the coast. Ice is not much of a problem in the southerly tributaries. The upper part of Potomac River is closed during severe winters, and Patuxent River is closed nearly to the mouth. Severn River, strangely enough, is said to remain open except for short periods in severe winters. Susquehanna River, at the head of the bay, usually is completely closed for about 3 months. Ice conditions in the Eastern Shore tributaries correspond roughly to those across the bay.

(97) During some winter months or when threatened by icing conditions, lighted buoys may be removed from station or replaced by unlighted buoys; unlighted buoys, daybeacons, and lights on marine sites also may be removed. (See LIGHT LIST.)

(98) For icing hazards to vessels see Superstructure icing, following.

Weather

(99) Weather hazards can plague navigation along this stretch of coast in all seasons, whether sailing the open Atlantic or the more sheltered inland waterway.

(100) In this chapter, a brief seasonal overview of weather difficulties is followed by a summary of weather hazards and related problems. Detailed local weather problems are discussed in the appropriate chapters. Climatological summaries for coastal stations and marine areas can be found in the appendix.

(101) The area covered in this Coast Pilot is generally low and flat. Long stretches of sandy beaches and tidewater marshes characterize the New Jersey, Delaware, and Maryland ocean coasts. The eastern shore of Chesapeake Bay consists of low, flat, almost featureless plains, with numerous irregularities and small islands. The western shore is a gently rolling upland. Tidewater Virginia encompasses numerous flat peninsulas, wide estuaries, and many swamps. Topography farther inland rises in an irregular pattern of progressively higher northeast-southwest mountain ranges to the main Appalachian Mountains. Although some distance from the ocean, this mountain barrier exerts an important influence on the winter climatic pattern in the coastal area; it partly blocks the cold continental air from the interior, and this combines with the moderating effect of the ocean to produce a more equable climate than is found in continental locations in the same latitude elsewhere.

(102) Winter navigation is restricted by extratropical storms that ravage the mid-Atlantic coast. These low pressure systems, which develop over the interior Gulf of Mexico and off the southeastern coast, usually move northward through east-northeastward, sweeping through the mid-Atlantic coast often accompanied by

strong gusty winds and rain or snow. Highs from the interior usually follow the passage of these lows producing a pattern of rapidly changing air masses and variable winter weather from about November through March. There are marked temperature fluctuations and alternating periods of brief stormy weather, clear crisp days, and relatively mild conditions. A combination of strong winds, rough seas, and cold temperatures, can result in superstructure icing, where sea spray and sometimes precipitation can freeze to a ship's superstructure. This adds tremendous weight and creates dangerous instability.

(103) In spring a semipermanent fair weather system known as the Bermuda High, although still centered far to the southeast, begins to influence the southeast coast. The Middle Atlantic area is usually outside its circulation and is still subject to the passage of extratropical cyclones, frontal activity, and changing air masses. Warm rainy spells alternate with cool dry weather. Fog becomes a problem when warm air flows across still cold water.

(104) By early summer, the Bermuda High has built northward and westward, embracing the entire eastern seaboard with its circulation. It is responsible for the warm humid southerly flow that prevails. When it persists, the Bermuda High can block low pressure systems from the continent, providing a week or two of typical summertime weather, warm temperatures, high humidity, light to moderate southerly and southwesterly winds, and showers and thunderstorms. When pressure gradients are weak an alternating land-sea breeze is common along the coast. Summer is also the start of the hurricane season.

(105) The threat of tropical storms and hurricanes continues in autumn as the Bermuda High begins to shift southward and eastward and weaken. This leaves the coast under the influence of a weak continental high that gradually gives way to the winter weather pattern of increased frontal activity, winter storms, and migratory high pressure systems. While autumn brings a battle for control of the weather, these are mainly periods of dry sunny days and cool clear nights. During these periods there is the possibility of radiation type fog, forming inland at night and drifting out along the coast in the early morning. This fog is more localized than the spring advection fog and usually burns off before noon.

Climatological tables

(106) Climatological tables for coastal localities, and meteorological tables for the coastal ocean areas covered in this volume follow the appendix. The meteorological tables were compiled from observations made by ships in passage. Listed in the appendix are National Weather Service offices and radio stations which transmit weather information. The **Marine Weather Services Charts**, which contain additional important information, are available from the National Aeronautical Charting Office, AVN-5330, Federal Aviation Administration. (See appendix for address.)

Superstructure icing

(107) In certain weather conditions, ice accumulating on hulls and superstructures can be a serious danger to ships. Ice accumulation may occur from three causes:

(108) (a) Fog with freezing conditions;

(109) (b) Freezing rain or drizzle;

(110) (c) Sea spray or seas breaking over the ship when the air temperature is below the freezing point of seawater (about 28.6°F, -1.89°C).

(111) Ice accumulation from the first two causes, if appreciable, could induce enough damage to the rigging to cause it to fall. This is minor, however, in comparison with the weight of the ice accumulated in rough weather and low temperatures, when large amounts of spray and often heavy seas break over a vessel. When the air temperature is below the freezing point of sea water and the ship is in heavy seas, considerable amounts of water will freeze to the superstructure and those parts of the hull which are sufficiently above the waterline to escape being frequently washed by the sea. The amounts frozen to surfaces exposed to the air will rapidly increase with falling air and sea temperatures, and might in extreme cases lead to capsizing of the vessel. The dangerous conditions are those in which gale-force winds last for several days in association with air temperatures of 28°F (-2.2°C) or lower. These conditions will normally occur when the wind comes from the northern quadrants. Indications of when these conditions are likely to occur can often be obtained by observing the rate of fall of the barometer, at the onset of strengthening winds from a cold quarter, together with observations of air and sea temperatures.

(112) Superstructure icing at its worst can sink a small vessel. It elevates the center of gravity, decreasing the metacentric height. Icing increases the sail area and the heeling moment due to wind action. Its non-uniform distribution changes the trim; it can hamper steerability and lower ship speed. Icing can also cause hazardous deck conditions.

Pressure

(113) The pressure pattern changes considerably from summer to winter. At individual stations along the coast, however, the differences of mean annual pressure are quite small. The highest monthly mean pressure occurs during the winter and the lowest in late spring and early summer. Large short-term variations

of pressure are occasionally experienced during tropical cyclones in the late summer and autumn, and during the movement of extratropical cyclones and anticyclones in the winter and spring. The day-to-day changes of pressure in summer are less marked and average lower than in winter.

Winds

(114) Prevailing winds at most stations are from northwest during the cooler months, October through March, and from the southwest, May through September. The average wind speeds during the warmer months are generally lower than during the colder seasons, because of the absence of extratropical cyclones. Highest average speeds occur in March and lowest in August.

(115) In the winter, the winds over the open ocean are slightly stronger than those over land. Little difference is apparent in summer. In the warmer season, a daily shift in wind direction occurs when the region is not under the influence of cyclonic storms. During the warmer part of the day winds blow onshore, and during the cooler part, offshore. This land-sea breeze seldom penetrates more than a few miles inland.

(116) Gales (force 8 or higher) are reported in about 6 percent of ships' observations in winter. Gales are generally from the westerly quadrants. Summer gales are rare, but may be encountered during tropical cyclones or local thunderstorms.

Temperatures

(117) Along the Middle Atlantic Coast temperatures are generally moderate. Mean annual temperatures range from 55.1°F (12.8°C) at Philadelphia to 60.1°F (15.6°C) at Norfolk. The lowest mean monthly temperature is 31.1°F (-0.5°C) at Trenton in January; the highest, 79.4°F (26.3°C) at Norfolk in July. January is the coldest month and July the warmest. Over the open water areas, January mean air temperatures may be several degrees warmer than at coastal points, and in July they may be a few degrees cooler. Over land surfaces, the air warms and cools readily, but over water it does so slowly and relatively little. Land surfaces absorb heat in only a thin surface layer and give it up freely, while water absorbs heat to substantial depths and retains it longer.

(118) The daily temperature range averages from 10° to 20°F (12.2° to 6.7°C) throughout the year, and is generally much less over the water. Readings in the coastal areas rarely exceed 100°F (37.8°C), and the 90°F (32.2°C) level is reached on only one-third to one-half of the days during summer. Freezing temperatures (<0°C) are probable on one-half or more of the days from November through March, except from Maryland southward where the average is about one in three. Below-zero readings (<-17.8°C) have been recorded during December, January, and February at most stations, except Dover where no reading below 0°F (-17.8°C) has ever been observed.

(119) Sea-surface temperatures are warmer than air temperatures most of the time, ranging from 4° to 7°F (15.6° to 13.9°C) warmer in winter to about the same temperature in the spring.

Relative humidity

(120) Throughout the year the relative humidity is high, averaging from 64 to 90 percent at 0700 and from 46 to 62 percent at 1900. Humidities usually are higher with onshore winds (blowing from sea toward land) and lower with offshore winds (blowing from land toward sea).

Cargo care

(121) High humidities and temperature extremes can be encountered navigating the East Coast and may cause sweat damage to cargo. This problem is most likely when cargoes are loaded in warm summer air or can occur anytime temperatures fluctuate rapidly.

(122) When free air has a higher dewpoint than the temperature of the surface with which it comes in contact, the air is often cooled sufficiently below its dewpoint to release moisture. When this happens condensation will occur on board ship either on relatively cool cargo or on the ship's structure within the hold, where it drips onto the cargo. If cargo is stowed in a cool climate and the vessel sails into warmer waters, ventilation of the hold with outside air can lead to sweat damage of any moisture sensitive cargo. Unless the cargo generates internal heat, then as a rule, external ventilation should be shut off. When a vessel is loaded in warm weather and moves into a cooler region, vulnerable cargo should be ventilated.

(123) In general, whenever accurate readings show the outside air has a dewpoint below the dewpoint of the air surrounding the vulnerable cargo, such outside air is capable of removing moisture and ventilation may be started. However, if the outside dewpoint is higher than the dewpoint around the cargo, ventilation will increase moisture and result in sweating. This generality does not take into account the possibility of necessary venting for gases or fumes.

Cloudiness and precipitation

(124) At sea in winter, overcast conditions (cloud amount 0.8 or more) are recorded in 45 to 50 percent of observations, while clear conditions (0.2 or less) are recorded in about 30 percent. In summer, some 30 to 35 percent of observations show overcast and an equal

percent, clear skies. The least cloudiness occurs when the air is dominated by the Bermuda High in late summer and early autumn, and the greatest cloudiness during the frequent winter cyclones. In the coastal area, from one-third to one-half the days are overcast in winter, and 25 to 35 percent in summer.

(125) Precipitation over the coastal sections is moderately heavy and well distributed. Normal monthly totals vary from minima of about 2.5 to 3.0 inches (64 to 76 mm) in February or October to maxima of 4.5 to 6.0 inches (114 to 152 mm) in August. Annual totals range between 41 and 45 inches (1041 and 1143 mm). Summer thunderstorms are most frequent over land and near coastal waters in the afternoon; at night they are more frequent over open water. Thunderstorm rainfall is less intense over the ocean, but can severely restrict visibility. Snow may be expected from November through March; maximum fall is in January and February. Snow usually does not remain on the ground for extended periods. On rare occasions, freezing rain, or glaze, is encountered; if prolonged, it can cause damage to rigging. Snow at sea is little more than a severe restriction to visibility.

Visibility

(126) Although generally good, visibility can be hampered by fog, precipitation, haze and smoke. Fog is usually the most restrictive. It is most likely over open waters in spring and early summer when warm moist air moves across still cool waters. Off the coast from March through June, this advection fog restricts visibility to less than 0.5 mile (0.80 km), 3 to 8 percent of the time. Visibilities fall below 2 miles (3.2 km), 5 to 12 percent of the time during this period. While advection fog sometimes drifts onshore, radiation fog in autumn and winter is more common just inland. Radiation fog forms on calm, clear nights and may drift over water during the early morning hours. It usually burns off by noon. At coastal locations visibilities fall below 0.25 mile (0.40 km) about 2 to 5 days per month from September through March; some locations suffer through June if they are exposed to sea fog. Smoke and haze by themselves rarely reduce visibilities below 2 miles (3.2 km) but precipitation can briefly, particularly in heavy showers.

Thunderstorms

(127) While they can develop in any month, thunderstorms are most likely from May through October. They can occur in squall lines or a single cell; stirring a breeze or creating gusts to 100 knots. Thunderstorms can spring up rapidly or be tracked for several days; bring gentle showers or a torrential downpour. Thunderstorms can harbor a tornado or waterspout and produce vivid lightning displays. The number of thunderstorms can vary from year to year, but on the average they can be expected on 4 to 10 days per month from May through August.

(128) Along the coast and over the bays, thunderstorms are most likely from midafternoon through the evening. These are the typical air mass thunderstorms that result from warm moist air being heated and forced to rise. Cold fronts can also generate thunderstorms and often squall lines, which can occur at any time. When thunderstorms coincide with the time of maximum daily heating, they are most violent. In spring and early summer, thunderstorms usually develop to the west and southwest and approach at 20 to 35 knots; they are often severe. As summer progresses air mass thunderstorms are more likely. These form to the west and east of Chesapeake Bay and move eastward at about 10 to 20 knots.

Tropical Cyclones

(129) Tropical storms and hurricanes are an infrequent but dangerous threat to navigation. At sea, winds can reach 175 knots or more and waves of 35 to 40 feet (11 to 12 m) are likely; in an intense storm the waves may exceed 50 feet (15 m). On the coast, storm tides as much as 17 feet (5 m) or more above mean sea level are possible as is rainfall of 15 inches (381 mm) or more. A tropical cyclone is a warm-core, low-pressure system that develops over the warm waters of the tropical oceans, and exhibits a rotary, counterclockwise circulation in the Northern Hemisphere (clockwise in the Southern Hemisphere). Tropical cyclones occur almost entirely in six rather distinct regions of the world; one of these, the **North Atlantic Region** (West Indies, Caribbean Sea, Gulf of Mexico, and waters off the east coast of the United States), includes the area covered by this Coast Pilot. In this region, tropical cyclones with winds of 34 to 63 knots are called **tropical storms,** while tropical cyclones with winds greater than 63 knots are called hurricanes. **Hurricanes** are infrequent in comparison with middle-and high-latitude storms, but they have a record of destruction far exceeding that of any other type of storm. Because of their fury, and the fact that they are predominately oceanic, they merit the special attention of all mariners, whether professional or amateur.

(130) While tropical cyclones can occur at any time, they are most likely from June through early November. Along this section of the coast their greatest frequency occurs from mid-August through September. They are often in the process of recurving and tend to parallel the coastline. The most dangerous storms are those that move slowly northward and remain just off the coast. Fortunately, tropical cyclones tend to accelerate

as they move into higher latitudes; forward speeds of 20 to 30 knots are not uncommon.

(131) Rarely does the mariner who has experienced a fully developed tropical cyclone (hurricane) at sea wish to encounter a second one. He has learned the wisdom of avoiding them if possible. The uninitiated may be misled by the deceptively small size of a tropical cyclone as it appears on a weather map, and by the fine weather experienced only a few hundred miles from the reported center of such a storm. The rapidity with which the weather can deteriorate with approach of the storm, and the violence of the hurricane, are difficult to visualize if they have not been experienced.

(132) As a tropical cyclone moves out of the Tropics to higher latitudes, it normally loses energy slowly, expanding in area until it gradually dissipates or acquires the characteristics of extratropical cyclones. At any stage, a tropical cyclone normally loses energy at a much faster rate if it moves over land. As a general rule, tropical cyclones of the North Atlantic Region move with the prevailing winds of the area. In small hurricanes the diameter of the area of destructive winds may not exceed 25 miles (40 km) while in some of the greatest storms the diameter may be as much as 400 to 500 miles (644 to 805 km).

(133) At the center is a comparative calm known as the **eye** of the storm. The diameter of this eye varies with individual storms and may be as little as 7 miles (11 km), but is rarely more than 30 miles (48 km). The average is 15 to 20 miles (24 to 32 km). This center is the region of low atmospheric pressure around which winds blow in a more or less circular course, spiraling inward in a counterclockwise direction. Winds at the outer edge of the storm area are light to moderate and gusty, and often increase toward the center to speeds too high for instrument recording. Although the air movement near the center of the hurricane is usually light and fitful, the seas in this area are in most cases very heavy and confused, rendered so by the violent shifting winds which surround it. Furthermore, after the center has passed a vessel, she may expect a sharp renewal of the gales, with winds from a more or less opposite direction. The hurricane may effect an area covering tens of thousands of square miles.

(134) In an average year over the entire North Atlantic (including the Caribbean Sea and the Gulf of Mexico) about nine or ten tropical cyclones come to life and about six of these reach hurricane strength. They usually form over a wide range of ocean between the Cape Verde Islands and the Windward Islands, over the western Caribbean Sea, and in the Gulf of Mexico. While some may initially move northward most take a westerly to northwesterly course. Of these, some curve gradually northward either east or north of the larger islands of the West Indies, then finally turn northeastward or eastward off the U.S. Atlantic coast.

(135) A considerable number, however, remain in low latitudes and do not turn appreciably to the northward. Freak movements are not uncommon, and there have been storms that described loops, hairpin-curved paths, and other irregular patterns. Movement toward the southeast is rare, and in any case of short duration. The entire Caribbean area, the Gulf of Mexico, the coastal regions bordering these bodies of water, and the Atlantic Coast are subject to these storms during the hurricane season.

(136) Hurricanes develop over the southern portions of the North Atlantic, including the Gulf of Mexico, and Caribbean Sea, **mostly from June through October, infrequently in May and November, and rarely in other months;** the hurricane season reaches its peak in September. An average of nine tropical cyclones form each year (reaching at least tropical storm intensity), and five of these reach hurricane strength. June and July storms tend to develop in the northwestern Caribbean or Gulf of Mexico; during August there is an increase in number and intensity, and the area of formation extends east of the Lesser Antilles. September storms develop between 50° W and the Lesser Antilles, in the southern Gulf of Mexico, the western Caribbean, near the Bahamas, and around the Cape Verde Islands. Formation in October shifts primarily to the western Caribbean, and off-season storms are widespread with a slight concentration in the southwestern Caribbean.

(137) The average speed of movement of tropical cyclones in the Tropics is about 10 to 15 knots. This speed, however, varies considerably according to the location of the storm, its development, and attendant meteorological conditions. The highest rates of progression usually occur when the storm is moving northward or northeastward in the middle or higher latitudes.

Extratropical cyclones

(138) These winter-type storms, while abundant all year, are most intense from fall through spring. Along this coast they are often known as "Nor'easters". They can generate hurricane-force winds and can vary in size from 100 miles to nearly 1,000 miles (160 to 1,600 km) in diameter. Waves generated by these storms commonly exceed 40 feet (12 m) and have been reported at more than 60 feet (18 m) in the open ocean. Like tropical cyclones, they can devastate the shore, rearrange the coastal topography, and cause extensive flooding.

(139) These storms generally move into this region from the west or southwest. Those from the Gulf of Mexico area are usually more intense because of their overwater route. They often intensify off Cape Hatteras

before sweeping northeastward. Heavy rain or snow before the passage of the storm center may be extensive. After the center passes, northwesterly winds coming from the interior may be strong and cold. The classic "Nor'easter" is so called because winds over the coastal area are out of the northeast. They may occur at any time, but are most frequent and violent between September and April. They often develop off the mid-Atlantic coast and head northeastward toward New England.

Locating and tracking tropical cyclones

(140) By means of radio, the National Weather Service collects weather observations daily from land stations, ships at sea, and aircraft. When a tropical cyclone is located, usually in its early formative stage, it is followed closely. In the North Atlantic, U.S. Navy, Air Force, and NOAA aircraft make frequent flights to the vicinity of such storms to provide information needed for tracking the tropical cyclone and determining its intensity. Long-range shore radar stations follow the movement of the storm's precipitation area when it is in range. Bulletins are broadcast to ships several times daily, giving information on each storm's location, intensity, and movement. As a further aid, the mariner may obtain weather reports by radio directly from other ships in the vicinity of a tropical cyclone.

Signs of approach

(141) Although radio reports normally prove adequate for locating and avoiding a tropical cyclone, knowledge of the appearance of the sea and sky in the vicinity of such a storm is useful to the mariner. The passage of a hurricane at sea is an experience not soon to be forgotten.

(142) An early indication of the approach of such a storm is the presence of a long swell. In the absence of a tropical cyclone, the crests of swell in the deep waters of the Atlantic pass at the rate of perhaps eight per minute. Swell generated by a tropical cyclone is about twice as long, the crests passing at the rate of perhaps four per minute. Swell may be observed several days before arrival of the storm.

(143) When the storm center is 500 to 1,000 miles away, the barometer usually rises a little, and the skies are relatively clear. Cumulus clouds, if present at all, are few in number, and their vertical development appears suppressed. The barometer usually appears restless, pumping up and down a few hundredths of an inch.

(144) As the tropical cyclone comes nearer, a cloud sequence begins which resembles that associated with the approach of a warm front in middle latitudes. Snow-white, fibrous "mare's tails" (cirrus) appear when the storm is about 300 to 600 miles away. Usually these seem to converge, more or less, in the direction from which the storm is approaching. This convergence is particularly apparent at about the time of sunrise and sunset.

(145) Shortly after the cirrus appears, but sometimes before, the barometer starts a long, slow fall. At first the fall is so gradual that it only appears to alter somewhat the normal daily cycle (two maximums and two minimums in the Tropics). As the rate of fall increases, the daily pattern is completely lost in the more or less steady fall.

(146) The cirrus becomes more confused and tangled, and then gradually gives way to a continuous veil of cirrostratus. Below this veil, altostratus forms, and then stratocumulus. These clouds gradually become more dense, and as they do so, the weather becomes unsettled. A fine, mistlike rain begins to fall, interrupted from time to time by showers. The barometer has fallen perhaps a tenth of an inch.

(147) As the fall becomes more rapid, the wind increases in gustiness, and its speed becomes greater, reaching a value of perhaps 22 to 40 knots (Beaufort 6-8). On the horizon appears a dark wall of heavy cumulonimbus, the **bar** of the storm. Portions of this heavy cloud become detached from time to time and drift across the sky, accompanied by rain squalls and wind of increasing speed. Between squalls, the cirrostratus can be seen through breaks in the stratocumulus.

(148) As the bar approaches, the barometer falls more rapidly and wind speed increases. The seas, which have been gradually mounting, become tempestuous and, squall lines, one after the other, sweep past in ever increasing number and intensity.

(149) With the arrival of the bar, the day becomes very dark, squalls become virtually continuous, and the barometer falls precipitously, with a rapid increase in the wind speed. The center may still be 100 to 200 miles away in a hurricane. As the center of the storm comes closer, the ever-stronger wind shrieks through the rigging and about the superstructure of the vessel. As the center approaches, rain falls in torrents. The wind fury increases. The seas become mountainous. The tops of huge waves are blown off to mingle with the rain and fill the air with water. Objects at a short distance are not visible. Even the largest and most seaworthy vessels become virtually unmanageable, and may sustain heavy damage. Less sturdy vessels do not survive. Navigation virtually stops as safety of the vessel becomes the prime consideration. The awesome fury of this condition can only be experienced. Words are inadequate to describe it.

(150) If the eye of the storm passes over the vessel, the winds suddenly drop to a breeze as the wall of the eye passes. The rain stops, and skies clear sufficiently to permit the sun to shine through holes in the

comparatively thin cloud cover. Visibility improves. Mountainous seas approach from all sides, apparently in complete confusion. The barometer reaches its lowest point, which may be 1½ to 2 inches below normal in hurricanes. As the wall on the opposite side of the eye arrives, the full fury of the wind strikes as suddenly as it ceased, but from the opposite direction. The sequence of conditions that occurred during approach of the storm is reversed, and pass more quickly, as the various parts of the storm are not as wide in the rear of a storm as on its forward side.

Locating the center of a tropical cyclone

(151) If intelligent action is to be taken to avoid the full fury of a tropical cyclone, early determination of its location and direction of travel relative to the vessel is essential. The bulletins and forecasts are an excellent general guide, but they are not infallible and may be sufficiently in error to induce a mariner in a critical position to alter course so as to unwittingly increase the danger of the vessel. Often it is possible, using only those observations made aboard ship, to obtain a sufficiently close approximation to enable the vessel to maneuver to the best advantage.

(152) As previously stated, the presence of an exceptionally long swell is usually the first visible indication of the existence of a tropical cyclone. In deep water it approaches from the general direction of origin (the position of the storm center when the swell was generated). However, in shoaling water this is a less reliable indication because the direction is changed by refraction, the crests being more nearly parallel to the bottom contours.

(153) When the cirrus clouds appear, their point of convergence provides an indication of the direction of the storm center. If the storm is to pass well to one side of the observer, the point of convergence shifts slowly in the direction of storm movement. If the storm center will pass near the observer, this point remains steady. When the bar becomes visible, it appears to rest upon the horizon for several hours. The darkest part of this cloud is in the direction of the storm center. If the storm is to pass to one side, the bar appears to drift slowly along the horizon. If the storm is heading directly toward the observer, the position of the bar remains fixed. Once within the area of the dense, low clouds, one should observe their direction of movement, which is almost exactly along the isobars, with the center of the storm being 90° from the direction of cloud movement (left of direction of movement in the Northern Hemisphere).

(154) The winds are probably the best guide to the direction of the center of a tropical cyclone. The circulation is cyclonic, but because of the steep pressure gradient near the center, the winds there blow with greater violence and are more nearly circular than in extratropical cyclones.

(155) According to Buys Ballot's law, an observer who faces into the wind has the center of the low pressure on his right (Northern Hemisphere) and somewhat behind him. If the wind followed circular isobars exactly, the center would be exactly eight points, or 90°, from dead ahead when facing into the wind. However, the track of the wind is usually inclined somewhat toward the center, so that the angle dead ahead varies between perhaps 8 and 12 points (90° to 135°). The inclination varies in different parts of the same storm. It is least in front of the storm, and greatest in the rear, since the actual wind is the vector sum of that due to the pressure gradient and the motion of the storm along the track. A good average is perhaps ten points in front, and 11 or 12 points in the rear. These values apply when the storm center is still several hundred miles away. Closer to the center, the wind blows more nearly along the isobars, the inclination being reduced by one or two points at the wall of the eye. Since wind direction usually shifts temporarily during a squall, its direction at this time should not be used for determining the position of the center.

(156) When the center is within radar range, it might be located by this equipment. However, since the radar return is predominately from the rain, results can be deceptive, and other indications should not be neglected.

(157) Distance from the storm center is more difficult to determine than direction. Radar is perhaps the best guide. The rate of fall of the barometer is of some help; this is only a rough indication, however, for the rate of fall may be quite erratic and will vary somewhat with the depth of the low at the center, the speed of the storm center along its track, and the stage in the life cycle of the storm.

Maneuvering to avoid the storm center

(158) The safest procedure with respect to tropical cyclones is to avoid them. With the aid of ship observations, satellite information and computers, there is ample warning time, usually 24 to 48 hours, to prepare for the approach of a tropical cyclone along this coast. These warnings are given wide distribution by commercial radio and television, Coast Guard and NOAA weather radio, and by visual displays whenever winds, weather, sea conditions or storm tides are expected to be a hazard to marine operations. If action is taken sufficiently early, this is simply a matter of setting a course that will take the vessel well to one side of the probable track of the storm, and then continuing to plot the position of the storm center, as given in the weather bulletins, revising the course as needed. Detailed

information on the vulnerability of North Atlantic ports to hurricanes may be found in the **Hurricane Havens Handbook for the North Atlantic Ocean** published by the Marine Meteorology Division, Naval Research Laboratory, Monterey, CA 93943 and available on the internet at https://www.cnmoc.navy.mil/. Additional local information may be found in the individual chapters of this book.

(159) However, such action is not always possible. If one finds himself within the storm area, the proper action to take depends in part upon his position relative to the storm center and its direction of travel. It is customary to divide the circular area of the storm into two parts. In the Northern Hemisphere, that part to the **right** of the storm track (facing in the direction toward which the storm is moving) is called the **dangerous semicircle.** It is considered dangerous because (1) the actual wind **speed** is greater than that due to the pressure gradient alone, since it is augmented by the forward motion of the storm, and (2) the **direction** of the wind and sea is such as to carry a vessel into the path of the storm (in the forward part of the semicircle). The part to the **left** of the storm track is called the **navigable semicircle.** In this part, the wind is decreased by the forward motion of the storm, and the wind blows vessels away from the storm track (in the forward part). Because of the greater wind speed in the dangerous semicircle, the seas are higher here than in the navigable semicircle.

(160) A plot of successive positions of the storm center should indicate the semicircle in which a vessel is located. However, if this is based upon weather bulletins, it is not a reliable guide because of the lag between the observations upon which the bulletin is based and the time of reception of the bulletin, with the ever present possibility of a change in the direction of motion of the storm. The use of radar eliminates this lag, but the return is not always a true indication of the center. Perhaps the most reliable guide is the wind. Within the cyclonic circulation, a **veering wind** (one changing direction to the right in the Northern Hemisphere and to the left in the Southern Hemisphere) indicates a position in the dangerous semicircle, and a **backing wind** (one changing in a direction opposite to a veering wind) indicates a position in the navigable semicircle. However, if a vessel is underway, its motion should be considered. If it is outrunning the storm or pulling rapidly toward one side (which is not difficult during the early stages of a storm, when its speed is low), the opposite effect occurs. This should usually be accompanied by a rise in atmospheric pressure, but if motion of the vessel is nearly along an isobar, this may not be a reliable indication. If in doubt, the safest action is usually to stop long enough to determine definitely the semicircle. The loss in valuable time may be more than offset by the minimizing of the possibility of taking the wrong action and increasing the danger to the vessel. If the wind direction remains steady (for a vessel which has stopped), with increasing speed and falling barometer, the vessel is in or near the path of the storm. If it remains steady with decreasing speed and rising barometer, the vessel is on the storm track, behind the center.

(161) The first action to take if one finds himself within the cyclonic circulation, is to determine the position of his vessel with respect to the storm center. **While the vessel can still make considerable way through the water, a course should be selected to take it as far as possible from the center.** If the vessel can move faster than the storm, it is a relatively simple matter to outrun the storm if sea room permits. But when the storm is faster, the solution is not as simple. In this case, the vessel, if ahead of the storm, will approach nearer to the center. The problem is to select a course that will produce the greatest possible minimum distance. This is best determined by means of a relative movement plot.

(162) As a very general rule, for a vessel in the Northern Hemisphere, safety lies in placing the wind on the starboard bow in the dangerous semicircle and on the starboard quarter in the navigable semicircle. If on the storm track ahead of the storm, the wind should be put about two points on the starboard quarter until the vessel is well within the navigable semicircle, and the rule for that semicircle then followed. With a faster than average vessel, the wind can be brought a little farther aft in each case. However, as the speed of the storm increases along its track, the wind should be brought farther forward. If land interferes with what would otherwise be the best maneuver, the solution should be altered to fit the circumstances. If the speed of the vessel is greater than that of the storm, it is possible for the vessel, if behind the storm, to overtake it. In this case, the only action usually needed is to slow enough to let the storm pull ahead.

(163) In all cases, one should be alert to changes in the direction of movement of the storm center, particularly in the area where the track normally curves toward the pole. If the storm maintains its direction and speed, the ship's course should be maintained as the wind shifts.

(164) If it becomes necessary for a vessel to heave to, the characteristics of the vessel should be considered. A power vessel is concerned primarily with damage by direct action of the sea. A good general rule is to heave to with head to the sea in the dangerous semicircle or stern to the sea in the navigable semicircle. This will result in greatest amount of headway away from the storm center, and least amount of leeway toward it. If a vessel handles better with the sea astern or on the quarter, it may be placed in this position in the navigable

semicircle or in the rear half of the dangerous semicircle, but never in the forward half of the dangerous semicircle. It has been reported that when the wind reaches hurricane speed and the seas become confused, some ships ride out the storm best if the engines are stopped, and the vessel is permitted to seek its own position. In this way, it is said, the ship rides with the storm instead of fighting against it.

(165) In a sailing vessel, while attempting to avoid a storm center, one should steer courses as near as possible to those prescribed above for power vessels. However, if it becomes necessary for such a vessel to heave to, the wind is of greater concern than the sea. A good general rule always is to heave to on whichever tack permits the shifting wind to draw aft. In the Northern Hemisphere this is the starboard tack in the dangerous semicircle and the port tack in the navigable semicircle.

Practical rules

(166) When there are indications of a hurricane, vessels should remain in port or seek one if possible. Changes in barometer and wind should be carefully observed and recorded, and every precaution should be taken to avert damage by striking light spars, strengthening moorings, and if a steamer, preparing steam to assist the moorings. In the ports of the southern States hurricanes are generally accompanied by very high tides, and vessels may be endangered by overriding the wharf where moored if the position is at all exposed.

(167) Vessels in the Straits of Florida may not have sea room to maneuver so as to avoid the storm track, and should try to make a harbor, or to stand out of the straits to obtain sea room. Vessels unable to reach a port and having sea room to maneuver usually observe the previously discussed general rules for avoiding the storm center, which, for power-driven vessels, are summarized as follows:

(168) **Right or dangerous semicircle**.–Bring the wind on the starboard bow (045° relative), hold course, and make as much way as possible. If obliged to heave to, do so with head to the sea.

(169) **Left or navigable semicircle**.–Bring the wind on the starboard quarter (135° relative), hold course, and make as much way as possible. If obliged to heave to, do so with stern to the sea.

(170) **On storm track, ahead of center**.–Bring the wind two points on the starboard quarter (157½° relative), hold course, and make as much way as possible. When well within the navigable semicircle, maneuver as indicated above.

(171) **On storm track, behind center**.–Avoid the center by the best practicable course, keeping in mind the tendency of tropical cyclones to curve northward and eastward.

Coastal effects

(172) Along the coast, water may inflict greater damage than wind. The storm tide is the result of the tropical cyclone's pressure and wind on the normal astronomical tide. When these forces occur simultaneously with a normal high tide the resultant flooding can be devastating. Add to that the unusually high seas generated by the storm and there is the potential for a disaster. Aids to navigation may be blown out of position or destroyed. Craft in harbors, unless properly secured, may drag anchor and/or be blown against obstructions.

(173) When proceeding along a shore recently visited by a hurricane, a navigator should remember that time is required to restore aids to navigation which have been blown out of position or destroyed. In some instances the aid may remain, but its light, or sound apparatus may be inoperative. Landmarks may have been damaged or destroyed.

Dangerous waves along the Gulf Stream

(174) Winter and spring storms passing over the Gulf Stream along the east coast of the United States may be modified rapidly enough to create dangerous wind and wave situations. This is particularly true in the North Wall, a narrow band of extreme horizontal water temperature change that marks the northern edge of the Gulf Stream. In early winter, cold air outbreaks along this northern edge sometimes result in a doubling of the wind speed of surrounding seas. During February and March the waters north of the Gulf Stream are at their coldest while the Gulf Stream remains relatively warm. Also, from the North Wall to 10 to 20 miles into the Gulf Stream, strong northeasterly currents are encountered. The strong northeasterly winds of intense coastal storms tend to pull cold Arctic air across the slope water to near Cape Hatteras. As this cold air reaches the Gulf Stream it encounters rapidly increasing sea surface temperatures. This sudden warming produces an increase in wind speeds and gustiness. In turn, this causes higher and confused seas. In addition, these northeasterly seas encounter opposing currents of 3 to 5 knots resulting in a sharp increase in wave heights and much steeper wave slopes. Waves may even break. This action causes problems for small craft navigating inlets in waves of only a few feet in height. With 20- to 30-foot seas the result is dangerous to any ship. To avoid this problem it is often best in late winter and spring to cross the Gulf Stream as far east as possible, since the cold air should be modified somewhat, reducing the instability effect.

Principal ports

(175) The ports within the area of this Coast Pilot which have deep-draft commercial traffic are Delaware City, Del.; Wilmington, Del.; Marcus Hook, Pa.; Chester, Pa.; Philadelphia, Pa.; Gloucester City, N.J.; Atlantic City, N.J.; Camden, N.J.; Trenton, N.J.; Norfolk, Va.; Portsmouth, Va.; Newport News, Va.; Richmond, Va.; Piney Point, Md.; Alexandria, Va.; Cove Point, Md.; Cambridge, Md.; and Baltimore, Md.

Pilotage, General

(176) Pilotage is compulsory for all foreign vessels and U.S. vessels under register in the foreign trade. Pilotage is optional for coastwise vessels that have on board a pilot properly licensed by the Federal Government for the waters which the vessel travels.

(177) The Maryland Pilots maintain a pilot station at Cape Henry; Virginia State pilots maintain a pilot station at Cape Henry; pilots for Delaware Bay and River maintain a pilot station at Cape Henlopen; Maryland State pilots and pilots for Delaware Bay and River also maintain a joint pilot station at Chesapeake City, Md., on the Chesapeake and Delaware Canal.

(178) The Chesapeake and Interstate Pilots Association offers pilotage to U.S. vessels engaged in the coastwise trade. Pilotage is also available to public vessels. The association serves vessels transiting Chesapeake Bay and its tributaries, Chesapeake and Delaware Canal, and Delaware Bay and River. Chesapeake and Interstate Pilots Association has an office in Norfolk (telephone, 757-855-2733).

(179) The Interport Pilots Agency, Inc. offers pilotage to public vessels and private vessels in the coastal trade transiting the Delaware Bay and River, Chesapeake and Delaware Canal, Upper Chesapeake Bay, New York Harbor, Long Island Sound and other areas along the northeast coast. Arrangements for their services are made 24 hours in advance through the ship's agents or by contacting Interport Pilots Agency, Inc., 906 Port Monmouth Road, Port Monmouth, NJ 07758-0236, telephone 732-787-5554 (24 hours), or by e-mail at interport@verizon.net. Additional information about Interport Pilots can be obtained at http://www.interportpilots.com.

(180) Pilotage is available for foreign vessels and U.S. vessels under register, for all ports on the New Jersey seacoast from Sandy Hook to, and including Atlantic City, from the Sandy Hook Pilot Association, 201 Edgewater Street, Staten Island, NY 10305, telephone 718-448-3900, FAX 718-447-1582, email: **pilotoffice@sandyhookpilots.com.** A 24-hour advance notice is required.

(181) All pilot associations provide 24-hour service. Arrangements for pilots should be made well in advance through ships' agents.

(182) Detailed information on pilotage procedures is given in the text for the ports concerned.

Towage

(183) Tugs are available at all major ports; they can usually be obtained for the smaller ports on advance notice if none are available locally. Arrangements for tugs should be made in advance through ships' agents or the pilots. (See the text for the ports concerned as to the availability of tugs.)

Vessel Arrival Inspections

(184) Quarantine, customs, immigration, and agricultural quarantine officials are stationed in most major U.S. ports. (See appendix for addresses.) Vessels subject to such inspections generally make arrangements in advance through ships' agents. Unless otherwise directed, officials usually board vessels at their berths.

(185) **Harbormasters**, if available, are mentioned in the text. They generally have charge of the anchorage and berthing of vessels.

Supplies

(186) Water, marine supplies, other supplies and services, and all grades of heavy bunker oil, lubricants, and diesel oil are available to large vessels at Hampton Roads ports, Baltimore, and other major ports along the Delaware Bay and River.

(187) Gasoline, diesel fuel, water, and marine supplies and services can also be obtained at most of the smaller ports.

Repairs

(188) Large oceangoing vessels can be drydocked and have major repair work done at Philadelphia, Chester, Baltimore, Newport News, Norfolk, and Portsmouth. Repair facilities for smaller vessels are also available at many places in the area covered by this Coast Pilot. (See text.)

(189) Wrecking and salvage equipment is available at Philadelphia, Baltimore, and Norfolk.

Small-craft facilities

(190) Marine supplies, repair facilities, and other services for small craft are available at all the major ports, at numerous places on the New Jersey Intracoastal Waterway, and on many of the tributaries of the Chesapeake and Delaware Bays. For isolated places and small cities, the Coast Pilot describes the more important of these facilities; for large port areas, where individual facilities are too numerous to mention, the information given is more general. Additional information may be obtained from the series of small-craft charts published

for the many places, and from various local small-craft guides.

(191) **A vessel of less than 65.6 feet (20 meters) in length or a sailing vessel shall not impede the passage of a vessel that can safely navigate only within a narrow channel or fairway. (Navigation Rules, International-Inland Rule 9(b).)**

Standard time

(192) The area covered by this Coast Pilot uses eastern standard time (e.s.t.), which is 5 hours slow of Greenwich mean time (G.m.t.). Example: When it is 1000 at Greenwich it is 0500 at Philadelphia, Pa.

Daylight saving time

(193) Throughout the area of this Coast Pilot, clocks are advanced 1 hour on the first Sunday in April and are set back to standard time on the last Sunday in October.

Legal public holidays

(194) New Year's Day, January 1; Martin Luther King, Jr.'s Birthday, third Monday in January; Washington's Birthday, third Monday in February; Memorial Day, last Monday in May; Independence Day, July 4; Labor Day, first Monday in September; Columbus Day, second Monday in October; Veterans Day, November 11; Thanksgiving Day, fourth Thursday in November; and Christmas Day, December 25. The national holidays are observed by employees of the Federal Government and the District of Columbia, and may not be observed by all the States in every case.

(195) In the areas covered by this Coast Pilot, other holidays are observed: Martin Luther King Jr. Day, January 15, in Maryland; Lee-Jackson Day, third Monday in January, in Virginia; Presidential Inauguration Day, January 20, every fourth year in the District of Columbia; Lincoln's Birthday, February 12, in all States except irginia; Good Friday, in Delaware, New Jersey, Pennsylvania, and Maryland; Maryland Day, March 25, in Maryland; Confederate Memorial Day, last Monday in May, in Virginia; Memorial Day, May 30, in Maryland; Flag Day, June 14, in Pennsylvania; Columbus Day, October 12, in Maryland; Defender's Day, September 12, in Maryland; General Election Day, first Tuesday after the first Monday in November, except in the District of Columbia.